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VIBRATION IMPROVEMENT MODIFICATIONS LIGHT TABLE

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**NPIC/R-08/73
MARCH 1973**



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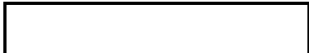
NPIC/R-08/73

TEST REPORT


ON

VIBRATION IMPROVEMENT MODIFICATIONS

25X1

 LIGHT TABLE

April 1973



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Test and Evaluation Branch
Engineering Support Division

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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VIBRATION IMPROVEMENT MODIFICATIONS
[REDACTED] LIGHT TABLE

1. INTRODUCTION

The vibration improvement modifications for the [REDACTED] MIM-4 Light Table are the results of a program, initiated by [REDACTED] to eliminate image vibration problems from their light table. They determined that a combination of five separate modifications were necessary to significantly reduce microscope vibration when tested on a shake table. In support of their program, DI-8 loaned an [REDACTED] light table (SN 00011) and the Test and Evaluation Branch (TEB), Engineering Support Division, loaned a vibration meter to [REDACTED]. On 20 December 1972, the modified [REDACTED] was delivered to TEB/NPIC for testing.

Observations made during the first few weeks after delivery indicated that [REDACTED] had achieved a high degree of success. A test program was then designed to determine the effect that each modification has and whether all modifications are necessary for [REDACTED] needs. This was accomplished by systematically testing all possible combinations in a vibration-prone area. This report contains test details and the conclusions drawn from them.

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2. DESCRIPTION OF EQUIPMENT

The vibration improvement modifications consisted of the following five items:

- o Stabilizers for the Y-axis guide rails. Each end plate was machined so that steel guide rails could be added. Ball bearings were then added to the ends of the Y-axis stabilizer shaft, which had been lengthened, to give extra support to the Y-axis carriage.
- o Power supply access cover. Cushions have been added to put a slight bow in the access cover to keep it from vibrating.
- o Elevation stabilizer shaft. The shaft has been stiffened by increasing its diameter from 1/2 inch to 1 inch.
- o Air bag mounts. Two air bag mounts have been attached to the lower rear portion of the light table such that the rear wheels are lifted off the floor by means of manual levers. The front wheels remain on the floor to control table sway.
- o Bridge Beam Damper. Stainless steel strips .02 inch thick by 1.37 inches wide by 40 inches long have been added to the upper and lower surfaces of the beam. Fiberglass spacers, .07 inch thick, are sandwiched between the strips and the beam. The strips and spacers are held together and to the beam by epoxy and screws. These attachments appear to add to the stiffness of the beam as well as to dampen the progress of vibrations through the beam.

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3. SUMMARY AND CONCLUSIONS

25X1 The combination of air bag mounts and bridge beam dampers has successfully eliminated bothersome image vibration from the [redacted] Light Table within TEB's present vibrational environment at microscope magnification levels up to 120X. The other three modifications, [redacted] showed no additional improvement.

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More specifically, the light table's response to both continuous floor vibration and to impact-created impulses has been improved. Continuous microscope vibration has not been eliminated, but it has been reduced in amplitude sufficiently to be imperceptible at low magnifications and barely perceptible at 120X. Large amplitude image excursions from occasional impulses still occur, but they now decay much more rapidly within a few oscillations.

25X1 This is the first successful attempt by a manufacturer to solve the vibration problem that our PIs have been experiencing. The key to [redacted] success may lie in the fact that they used a combination of isolation, stiffening, and damping. Previous attempts have only rigidized the bridge beam or isolated the entire table.

One word of caution is in order, however. Raising the rear wheels off the floor tilts the entire table forward approximately 4 degrees. Unless compensated for in some manner, this could create a problem in operating the microscope because it now rolls toward the operator when the X-Y locks are released. The tilt feature on the 1540 light tables created the same problem, and AIL solved it by providing a tilt-sensing Y-lock.

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4. TEST DETAILS

All tests were conducted with the modified [redacted] Light Table located at the center of a floor span which vibrates, consistently, at amplitudes which are considered typical of the problem areas within [redacted]

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Test 1 - Visible image vibration.

This test consisted of viewing a Foeppl vibration graticule through the optics of a [redacted] Zoom 240 Microstereoscope System. The graticule was observed through the right stereo optical path with the 5-inch rhomboid arm pointing toward the operator. Subjective observations were taken at six optical magnifications for each test setup. The levels of vibration observed were divided into three basic categories as follows:

- o No vibration. This includes infrequent small amplitude excursions.
- o Visible vibration but not bothersome. This is defined as continuous vibration of barely detectable amplitude and occasional short bursts of larger amplitude. For evaluation purposes, this category is considered borderline between acceptable and not acceptable performance.
- o Bothersome vibration. Includes all vibrations of larger amplitude.

Figure 1 shows that a combination of air bag and bridge beam damper eliminated the bothersome vibration up through 90X magnification. The data near the bottom of the page shows that the combination of the other three modifications does help when the air bags and bridge beam dampers are not implemented. However, their contribution is negligible otherwise. Due to the subjective nature of this test, small inconsistencies in the data should be ignored.

Figure 2 shows that the same results were obtained when the modifications were added to a second table. Two of the less significant modifications were not applied to the second table because of the amount of work involved.

Up to this point, the maximum magnification level used for visible vibration testing was 90X (16 and 17 January 1973).

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On 22 January 1973, additional tests were made using magnifications up to and including 120X. Figure 3 shows these results. Although there were only four combinations tested out of a possible 32, there is adequate proof that the same conclusions could be drawn.

Test 2 - Electronic vibration test.

25X1 This test consisted of impacting the floor in front of the [] light table and recording the resulting motion of a Zoom 240 mounted on the light table. The test equipment consisted of two geophones (one calibrated in horizontal velocity and the other in vertical velocity), a three-channel amplifier, and a two-channel stripchart recorder. The horizontal geophone was attached to the left stereo objective of the Zoom 240 such that it sensed front-to-back motion, and the vertical geophone was set on the floor by the right front wheel. The floor was then impacted with the heels of both feet sufficiently hard to produce full scale recordings from the vertical geophone. The resulting peak-to-peak velocity of the left stereo objective was read from the recording of the horizontal geophone. Figures 4 and 5 graphically show the test results.

Figures 4 and 5 show that the air bag mounts definitely decreases the amount of vibration that reaches the microscope from heel impact inputs. The other four modifications show a tendency to decrease vibration but not in significant amounts. This does not mean, however, that the bridge beam damper has no affect on impact inputs. Test 3 demonstrates how damping aids in the reduction of bothersome vibration.

Test 3 - Time constant.

Vibrational response of a device to an operator impulse (such as finger, fist, knee, or foot impact) would have a time constant of .12 second or less.* The "time constant" is the time for a vibration to reduce 63 percent of value, measured at an envelope position. Stripchart recordings from

* "Investigation, Cure of Vibrational Difficulties with Optical Equipment," Final Report Part I, [] 23 Aug 72

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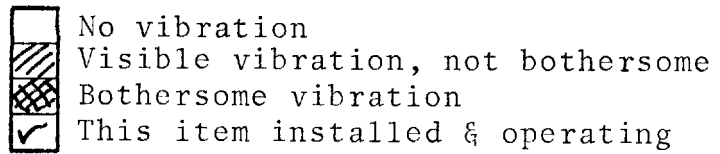
Test 2 were used to determine the time constant for both standard and modified bridge beam.

Figures 6 and 7 show typical time responses of the bridge beam before and after it had been modified. The other modifications are not related to the time constant associated with visible image vibration. It can be seen that the time constant for the modified bridge beam (.20 sec.) is less than one-half the time constant of the standard beam (.42 sec.). It should also be noted that the standard beam lingers at maximum vibration amplitudes while the modified beam starts to die down immediately. The overall effect is shorter bursts of image vibration with the modified beam.

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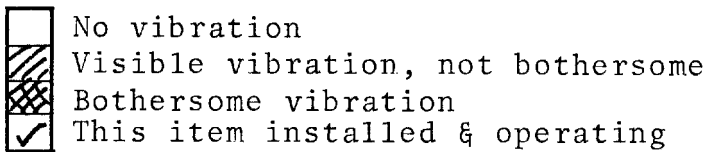
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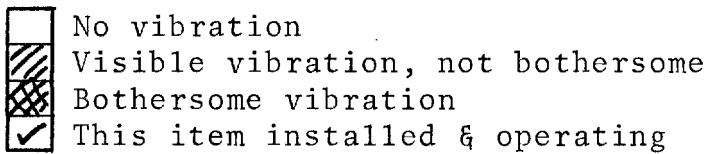
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This item installed & operating

Peak-to-Peak Velocity (inches/sec.)

0 .5 1.0 1.5 2.0 2.5 3.0 3.5

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This item installed & operating

Peak-to-Peak Velocity (inches/ sec.)

0 .5 1.0 1.5 2.0 2.5 3.0

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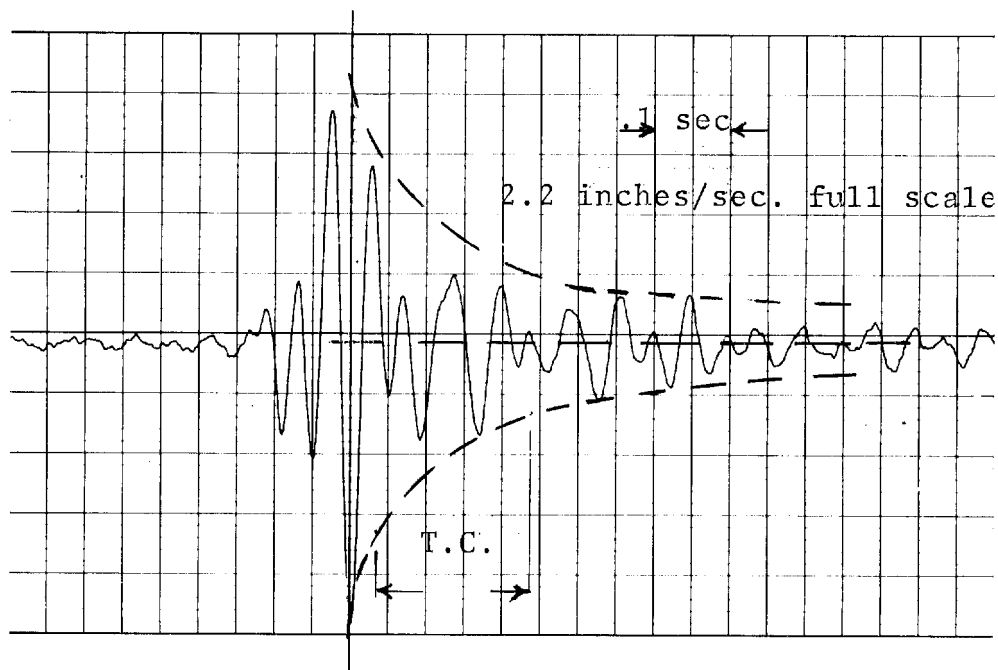


Figure 6: Time Constant for the Stiffened/Dampened Bridge Beam. Time Constant Equals .20 Second.

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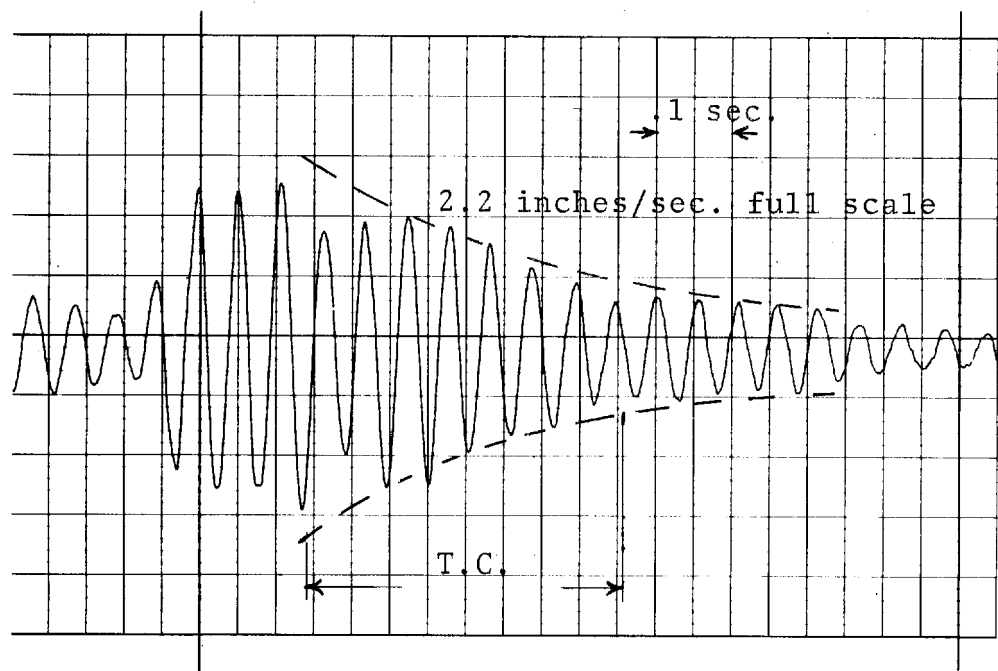


Figure 7: Time Constant for a Standard Bridge Beam. Time Constant Equals .42 Second.

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Comments and queries regarding this report are welcomed. They may be directed to [redacted] of TSG/ESD/TEB, Code 143, [redacted]

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